

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF HAWAII

PUBLIC UTILITIES
COMMISSION

2002 JAN 15 P 4:07

In the Matter of the Notice of)

HAWAIIAN ELECTRIC COMPANY, INC.)

Transmittal No. 02-01

To modify its Rule 14 to establish Interconnection)
Standards and to require an interconnection)
agreement for distributed generating facilities)
operating in parallel to the Company's electric)
electric system)

Effective

Date ~~February~~ **Postponed** 2002

This Notice of Hawaiian Electric Company, Inc. ("HECO" or "Company"), to modify its Rule 14 to establish Interconnection Standards and to require an interconnection agreement for distributed generating facilities operating in parallel to the Company's electric system, respectfully shows that:

I

Correspondence and communications in regard to this Transmittal No. 02-01 are to be addressed to:

William A. Bonnet
Vice President, Government and Community Affairs
Hawaiian Electric Company, Inc.
P. O. Box 2750
Honolulu, Hawaii 96840

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1099 Alakea Street, Suite 1800
Honolulu, Hawaii 96813

II

Hawaiian Electric Company, Inc., is a corporation organized and existing under the laws of the State of Hawaii, whose principal place of business is located at 900 Richards Street, Honolulu, Hawaii. HECO is an operating public utility engaged in the production, purchase, transmission, distribution, and sale of electricity on the island of Oahu.

III

Authorization to modify its Rule 14 to establish Interconnection Standards and to require an interconnection agreement for distributed generating facilities operating in parallel with the Company's electric system, is sought under the provisions of Sections 269-12(b) and 269-16(b), Hawaii Revised Statutes ("HRS"), and Rule 6-61-111 of the Commission's Rules of Practice and Procedure, Title 6, Chapter 61, Hawaii Administrative Rules ("HAR"). HECO requests that its proposed tariff changes be allowed to become effective on February 15, 2002. A copy of the proposed modification of Rule 14, including two appendices, is attached. A new Paragraph H, "Interconnection of Distributed Generating Facilities Operating in Parallel with the Company's Electric System", is attached as Sheet Nos. 34A-1 and 34A-2. In addition, the proposed Interconnection Standards and the proposed interconnection agreement are attached as Appendix I (Sheet Nos. 34B-1 to 34B-18), and Appendix II (Sheet Nos. 34C-1 to 34C-24), respectfully, to the Company's proposed modification to Rule 14.

IV

HECO's latest available balance sheet and income statement for the twelve months ending November 30, 2001, were filed with the Commission on December 27, 2001, and are

incorporated by reference pursuant to Rule 6-61-76 of the Commission's Rules of Practice and Procedure, Title 6, Chapter 61, HAR.

V

The proposed modification of Rule 14 to establish Interconnection Standards is intended to provide general technical guidelines and procedures to facilitate the interconnection and parallel operation of distributed generating facilities with the Company's utility electrical distribution system. The specific characteristics or needs of each distributed generating facility may reduce or increase its interconnection requirements. Because of the inherent complexity of network systems, requests for interconnection to network systems must be determined on a case-by-case basis. Also, requirements for interconnection to subtransmission or transmission systems may be more complicated, and must be determined on a case-by-case basis. These Interconnection Standards have been established to maintain safety, reliability, and power quality standards for all utility customers and personnel under the following objectives of good interconnection practice:

- Safety – To protect the safety of utility personnel, utility customers, and the public.
- Reliability – To maintain the reliability of the utility system for all utility customers.
- Power Quality – To provide for acceptable power quality and voltage regulation on the utility system and for all utility customers.
- Restoration – To facilitate restoration of power on the utility system.
- Protect Utility and Customer Equipment – To protect utility and customer equipment during steady state and faulted system operating conditions.
- Protect Generating Facilities – To protect generating facilities from operation of utility protective and voltage regulation equipment.

- Utility System Overcurrent Devices – To maintain proper operation of the utility system's overcurrent protection equipment.
- Utility System Operating Efficiency – To ensure operation at appropriate power factors and minimize system losses.

Customers are encouraged to review and discuss these technical Interconnection Standards with the utility before proceeding with their design and procurement of distributed generating facility equipment.

VI.

The proposed Interconnection Standards address the following:

- Definitions
- General Interconnection Guidelines
 - Compliance with Laws and Codes
 - Export of Power
 - Utility Feeder Penetration
 - Short Circuit Contribution Ratio (SCCR)
 - Network Interconnection
- Design Requirements
 - Integration with Utility Grounding and Ground System Protection
 - Transformer Winding Configuration
 - Isolation Device
 - Interrupting Device
 - Dedicated Transformer
 - Supervisory Control
 - Surge Capability
 - Equipment Testing
- Operating Requirements
 - Continuity of Service
 - Personnel and System Safety
 - Synchronization
 - Voltage Regulation
 - Unintended Islanding
 - Disconnect for Faults

- Voltage Disturbances
- Frequency Disturbances
- Inadvertent Energization
- Required Delay on Reconnection
- Loss of Protection
- Reclosing Coordination
- Power Factor
- Voltage Flicker
- Harmonics
- Direct Current Injection
- Protection from Electromagnetic Interference
- Technology Specific Requirements
 - Three-Phase Synchronous Generators
 - Induction Generators
 - Inverter Systems
- Protection, Synchronizing, and Control Requirements
 - Protection Requirements
 - Review of Design Drawings
- Typical Equipment & Protective Device Requirements for Large Synchronous, Induction, and Inverter Generators

VII

The proposed interconnection agreement is similar in form to power purchase agreements, except that it does not provide for the sale of power by the customer, or the purchase of power by the Company. The proposed Interconnection Standards are included as part of the proposed interconnection agreement. The proposed interconnection agreement addresses the following:

- Scope of the Agreement
- Parallel Operation of the Customer's Facility
- Interconnection Facilities Owned by the Company
- Customer Payments for Interconnection Facilities
- Commencement of Producing Energy in Parallel
- Incidental Deliveries of Energy
- Continuity of Service
- Personnel and System Safety
- Transmission Service Not Provided with Interconnection

- Prevention of Interference
- Location of Metering
- Design Reviews and Inspections
- Permits, Approvals, and Licenses
- Term of the Interconnection Agreement
- Termination of the Interconnection Agreement
- Disconnection and Survival of Obligations
- Indemnification
- Insurance
- Force Majeure
- Warranties
- Good Engineering Practice
- Miscellaneous Provisions
- Description of the Customer's Generating Facility
- The Facility Owned by the Customer or Third Party Owner
- Interconnection Facilities Owned by the Company

VIII

The proposed modification of Rule 14 is submitted pursuant to HRS Sections 269-12(b) and 269-16(b) and Rule 6-61-111 of the Commission's Rules of Practice and Procedure.

1. HRS Section 269-16(b) provides, in relevant part:

“(b) No rate, fare, charge, classification, schedule, rule, or practice, other than one established pursuant to an automatic rate adjustment clause previously approved by the commission, shall be established, abandoned, modified, or departed from by any public utility, except after thirty days' notice as prescribed in section 269-12(b) to the commission and prior approval by the commission for any increase in rates, fares, or charges.”

2. HRS Section 269-12(b) provides that:

“(b) Any notice provided pursuant to section 269-16(b), shall plainly state the rate, fare, charge, classification, schedule, rule, or practice proposed to be established, abandoned, modified, or departed from and the proposed effective date thereof and shall be given by filing the notice with the commission and keeping it open for public inspection.”

3. Rule 6-61-111 of the Commission Rules of Practice and Procedure provides:

“Public utility tariff filings. Except for tariff filings of water carriers and motor carriers that are governed by sections 6-61-93 and 6-61-94, any public utility tariff

2. HRS Section 269-12(b) provides that:

“(b) Any notice provided pursuant to section 269-16(b), shall plainly state the rate, fare, charge, classification, schedule, rule, or practice proposed to be established, abandoned, modified, or departed from and the proposed effective date thereof and shall be given by filing the notice with the commission and keeping it open for public inspection.”


3. Rule 6-61-111 of the Commission Rules of Practice and Procedure provides:

“Public utility tariff filings. Except for tariff filings of water carriers and motor carriers that are governed by sections 6-61-93 and 6-61-94, any public utility tariff additions or changes, other than tariff additions or changes which result in an increase in rates, fares, or charges or changes in any classifications, practices, or rules which would result in an increase in rates, fares, or charges, may be filed with the commission to become effective not less than thirty days after filing. The tariff page or pages to be added or changed shall be filed with the commission, together with a transmittal letter. The transmittal letter shall set forth the applicable information specified in section 6-61-74 and 6-61-86, together with the latest available balance sheet and income statement, the justification for the proposed additions or changes, and the proposed effective date thereof. The transmittal letter shall have attached to it a certificate of service showing service on the consumer advocate at the time of filing. Two copies of the tariff page or pages, together with the transmittal letter, shall be served on the consumer advocate. The additions or changes to the tariff, unless suspended by the commission, shall become effective thirty days after filing with the commission in compliance with this section or at a later date as may be specified in the transmittal letter. Tariff filings not in compliance with this section will be rejected.”

WHEREFORE, Hawaiian Electric Company, Inc., respectfully gives not less than 30 days' notice as required by law, and requests that its proposed modification to its Rule 14 to establish Interconnection Standards and to require an interconnection agreement for distributed generating facilities operating in parallel with the Company's electric system be allowed to become effective on February 15, 2002.

DATED: Honolulu, Hawaii, this 15th day of January 2002.

HAWAIIAN ELECTRIC COMPANY, INC.

By: 
William A. Bonnet
Vice President

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF HAWAII

In the Matter of the Notice of)	
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HAWAIIAN ELECTRIC COMPANY, INC.)	Transmittal No. 02-01
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Standards and to require an interconnection)	Date: Postponed 2002
agreement for distributed generating facilities)	
operating in parallel to the Company's electric)	
electric system)	
_____)	

VERIFICATION

STATE OF HAWAII)	
)	ss.
CITY AND COUNTY OF HONOLULU)	

William A. Bonnet, being first duly sworn, deposes and says: That he is the Vice President, Government and Community Affairs, of Hawaiian Electric Company, Inc. the applicant in the above proceeding, that he has read the foregoing notice, and knows the contents thereof; and that he is authorized by Hawaiian Electric Company, Inc., to verify that the contents of the application are true.

By: William A. Bonnet
William A. Bonnet
Vice President, Government and
Community Affairs

Subscribed and sworn to before me this
15th day of January, 2002.

Carolyn C. Kuwana
Notary Public Carolyn C. Kuwana
State of Hawaii

My commission expires: October 4, 2002

LS

RULE No. 14 (Continued)

Service Connections and Facilities on Customer's Premises

H. INTERCONNECTION OF DISTRIBUTED GENERATING FACILITIES
OPERATING IN PARALLEL WITH THE COMPANY'S ELECTRIC SYSTEM

1. Interconnection Standards

- a. Distributed generating facilities operating in parallel with the Company's electric system shall satisfy the Company's Interconnection Standards.
- b. The Company's Interconnection Standards are included as Appendix I to Rule 14.

2. Interconnection Agreement

- a. Customers on whose premises distributed generating facilities that are intended to operate in parallel with the Company's electric system are located shall complete and execute standard interconnection agreements with the Company prior to operating the distributed generating facilities in parallel with the Company's electric system, or within sixty (60) days after the effective date of this rule if the distributed generating facilities are already operating in parallel with the Company's system as of such date.
- b. Distributed generating facilities may be interconnected and operated in parallel with the Company's electric system in accordance with the terms and conditions of the interconnection agreement.
- c. The standard interconnection agreement required by paragraph H.2.a. is included as Appendix II to Rule 14. The standard interconnection agreement does not apply when (1) the Customer enters into a power purchase agreement for the sale to the Company of electric energy generated by the distributed

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generating facility, or (2) the Customer enters into a standard contract providing for net energy metering pursuant to Rule No. 18. A customer that has an executed interconnection agreement with the Company as of the effective date of this rule shall not be required to enter into the standard interconnection agreement until such time as the existing interconnection agreement is terminated.

- d. At the request of the Customer, the standard interconnection agreement may be modified by the Company to make both the Customer and a third party that is the owner and/or operator of the distributed generating facility parties to the interconnection agreement.
- e. Customers with distributed generating facilities that are eligible for net energy metering pursuant to Chapter 269 of the Hawaii Revised Statutes, and that meet the safety and performance standards referred to in Section 269-111 of the Hawaii Revised Statutes, shall not be required to install additional controls, perform or pay for additional tests or purchase additional liability insurance.

APPENDIX I

Distributed Generating Facility Interconnection Standards Technical Requirements

The following interconnection standards are intended to provide general technical guidelines and procedures to facilitate the interconnection and parallel operation of distributed generating facilities with the Hawaiian Electric Company, Inc. (HECO), Hawaii Electric Light Company (HELCO), and Maui Electric Company, Ltd. (MECO) utility electrical distribution systems. The specific characteristics or needs of each distributed generating facility may reduce or increase its interconnection requirements. Because of the inherent complexity of network systems, requests for interconnection to network systems must be determined on a case-by-case basis. Also, requirements for interconnection to subtransmission or transmission systems may be more complicated, and must be determined on a case-by-case basis. These technical interconnection requirements have been established to maintain safety, reliability, and power quality standards for all utility customers and personnel under the objectives described below:

Objectives of Good Interconnection Practice

- **Safety** – To protect the safety of utility personnel, utility customers, and the public.
- **Reliability** – To maintain the reliability of the utility system for all utility customers.
- **Power Quality** – To provide for acceptable power quality and voltage regulation on the utility system and for all utility customers.
- **Restoration** – To facilitate restoration of power on the utility system.
- **Protect Utility and Customer Equipment** – To protect utility and customer equipment during steady state and faulted system operating conditions.
- **Protect Generating Facilities** – To protect generating facilities from operation of utility protective and voltage regulation equipment.
- **Utility System Overcurrent Devices** – To maintain proper operation of the utility system's overcurrent protection equipment.
- **Utility System Operating Efficiency** – To ensure operation at appropriate power factors and minimize system losses.

Customers are encouraged to review and discuss these technical interconnection standards with the utility before proceeding with their design and procurement of distributed generating facility equipment.

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Transmittal 02-01, dated January 15, 2002

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1. Definitions

- a. Active Anti-Islanding Scheme: A control scheme installed with the generating facility that prevents the formation of an unintended island by accelerating the drift in voltage and/or frequency to the respective trip points when the utility is not connected.
- b. Clearing Time: The time between the abnormal voltage being applied and the generating facility ceasing to energize the utility distribution system.
- c. Dedicated Transformer: A transformer that provides electrical service to a single customer.
- d. Distribution System: All electrical wires, equipment, and other facilities at the distribution voltage levels (such as 25kV, 12kV, or 4kV) owned or provided by the utility, through which the utility provides electrical service to its customers.
- e. Direct Transfer Trip: Automatic remote trip of a generating facility's circuit breaker or interrupting device by means of a communication channel that is acceptable to the utility.
- f. Generating Facility: Customer or utility-owned electrical power generation that is interconnected to the utility.
- g. Induction Generator: A rotating machine generator that converts mechanical power to electrical power, in which the rotor current creating the magnetic field is supplied by an external AC source, usually the electric utility system.
- h. Inverter System: A machine, device, or system that changes direct-current power to alternating-current power.
- i. Network System: An electrical system in which two or more utility feeder sources are electrically tied together on the primary or secondary voltage level to form one power source for one or more customers. The network system is designed to provide higher reliability for customers connected to it.
- j. Point of Interconnection: The point at which the utility and the customer interface occurs.
- k. Short Circuit Contribution Ratio (SCCR): The ratio of the aggregate short circuit contribution of the generating facility to the short circuit contribution

of the utility system (including all other generating facility sources), for a three-phase fault at the high side of the customer or utility transformer.

- l. Subtransmission System: All electrical wires, equipment, and other facilities at the subtransmission voltage levels (such as 46kV, 35kV, or 23kV) owned or provided by the utility, through which the utility provides electrical service to its customers.
- m. Supervisory Control: Remote monitoring and/or control of a generating facility's power output and interrupting device status by means of a communication channel that is acceptable to the utility.
- n. Synchronous Generator: A rotating machine generator that converts mechanical power into electrical power, in which the rotor current creating the magnetic field comes from a separate DC source or the generator itself.
- o. Transmission System: All electrical wires, equipment, and other facilities at the transmission voltage levels (such as 138kV or 69kV) owned or provided by the utility, through which the utility provides electrical service to its customers.
- p. Unintended Islanding: Islanding is a condition in which one or more generating facilities deliver power to a utility customer or customers using a portion of the utility's distribution system that is electrically isolated from the remainder of the utility's distribution system. Unintended islanding may occur following an unanticipated loss of a portion of the utility distribution system.
- q. Utility-grade Protective Equipment: Protective equipment that meet requirements defined by:
 - ANSI/IEEE C37.90-1989 IEEE Standards for Relays and Relay Systems Associated with Electric Power Apparatus
 - IEEE C37.90.1 IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
 - IEEE C37.90.2 IEEE Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

2. General Interconnection Guidelines

- a. Compliance with Laws and Codes: The generating facility, protection, interconnection equipment, design, and design drawings shall meet all applicable national, state, and local laws, including construction and safety codes.
- b. Export of Power: Generating facilities intending to export power to the utility may require additional study to evaluate the impacts of the export power on equipment ratings and protective relay settings.
- c. Utility Feeder Penetration: As the penetration of generating capacity increases on the utility distribution feeder, there is increased risk of voltage regulation problems, adverse interactions with the utility's protection system, and unintended islanding. Therefore, additional study to examine the risk of voltage regulation problems, protection malfunction from reverse power flow, and unintended islanding may be required when the aggregate generating capacity per distribution feeder exceeds 10% of the peak annual KVA load of the feeder.

To avoid excessive unbalanced loading on the utility distribution feeder, interconnection of 1-phase generating facilities with a capacity greater than 10kW shall be reviewed on a case-by-case basis.

- d. Short Circuit Contribution Ratio (SCCR): A generating facility's short circuit current contribution to the utility distribution feeder can affect operation of existing utility protective devices. A good indicator of the potential impact of a generating facility's short circuit contribution is the Short Circuit Contribution Ratio, which is the ratio of the aggregate short circuit contribution of the generating facility to the short circuit contribution of the utility system (including all other generating facility sources), for a three-phase fault at the high side of the customer or utility distribution transformer. To ensure the operation of existing utility protective devices are not compromised, additional study may be required for generating facilities with an SCCR greater than 5%.
- e. Network Interconnection: Connection of generating facilities on utility distribution network systems shall be reviewed on a case-by-case basis.

3. Design Requirements

- a. Integration with Utility Grounding and Ground System Protection: The grounding scheme and the ground fault protection of the generating facility shall be coordinated with the utility system.

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- b. Transformer Winding Configuration: The transformer winding configuration of the customer or utility distribution transformer serving the generating facility shall be reviewed on a case-by-case basis, to determine the potential impact to the utility system and generating facility, and subsequent interconnection requirements. Refer to typical single-line diagrams in Figures 1-3.
- c. Isolation Device: The customer shall furnish and install a manual disconnect device that has a visible break to isolate their generating facility from the utility distribution system. The device must be accessible to utility personnel and be capable of being locked by utility personnel in the open position. For generating facilities that do not have a circuit breaker or interrupting device, the disconnect device must be capable of interrupting load. An existing service disconnect device may be used if it meets these requirements. A label provided by the utility (indicating "Customer Generating Facility") shall be attached to the generator disconnect device.
- d. Interrupting Device: Applicable circuit breakers or interrupting devices at the generating facility must be capable of interrupting the maximum available fault current at the site, including any contribution from the generating facility. For generating facilities that are greater than 10kW, the interrupting device must be accessible to utility personnel at all times.
- e. Dedicated Transformer: The utility may require the generating facility to install a dedicated transformer, where the generating facility is served from the same transformer secondary as another utility customer and if inverter-based technology is used that does not meet IEEE 929-2000 and IEEE 519-1992 (or latest versions) specifications. A dedicated transformer or other current-limiting device is needed for any type of generating facility where the increase in available short circuit current could adversely impact other utility customers on the same secondary circuit.
- f. Supervisory Control: For generating facilities intending to export power with an aggregate export capacity greater than 250kW, computerized supervisory control may be required and shall be reviewed on a case-by-case basis.

Supervisory control shall include monitoring of: (a) gross generation by the generating facility; (b) feedback of Watts, Vars, WattHours, current and voltage; (c) Vars furnished by the utility; and (d) status of the interrupting device. In addition, the supervisory control will allow the utility to trip the interrupting device during emergency conditions.

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- g. Surge Capability: The generating facility interconnection equipment and relays shall have the capability to withstand voltage and current surges in accordance with IEEE/ANSI Standard C62.41 or IEEE Standard C37.90.1 as appropriate.
- h. Equipment Testing: The generating facility shall provide to the utility the manufacturer's brochures/instruction manuals and technical specifications of their proposed generating facility equipment, and test reports for evaluation by the utility.

In addition, commissioning tests shall be performed on-site to verify protective settings and functionality to ensure that the equipment will not adversely affect the utility distribution system and that it will cease providing power to the system under abnormal conditions. A commissioning test shall be performed upon initial parallel operation of the generating facility, or whenever interface hardware or software is changed that can affect the protective functions. These tests shall be done by a qualified individual (hired by the customer) in accordance with the manufacturer's recommended test procedure and in concurrence with the utility. To ensure that commissioning tests are performed correctly, the utility may request to witness the tests and receive written certification of the results from the qualified individual.

All interconnection-related protective functions and transfer trip schemes, if applicable, shall be periodically tested at intervals specified by the manufacturer, or in accordance with industry practice. The customer shall submit or make available for inspection by the utility, test reports of such testing. Periodic testing conforming to the utility test intervals for the particular line section can be specified by the utility under special circumstances. A system that depends upon a battery for trip power shall be checked and logged once per month for proper voltage, or monitored continuously.

4. Operating Requirements

- a. Continuity of Service: Upon providing reasonable notice under the circumstances, the utility may require the generating facility to temporarily disconnect from the utility's system: (a) when necessary for the utility to construct, install, maintain, repair, replace, remove, investigate, test, or inspect any of its equipment or other utility customer's equipment, or any part of its system; or (b) if the utility determines that such disconnection is necessary because of a system emergency, forced outage, operating conditions on its systems, or compliance with good engineering practices.

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- b. Personnel and System Safety: The utility may disconnect the generating facility from the utility's system, without prior notice to the customer: (a) to eliminate conditions that constitute a potential hazard to the utility's personnel or the general public; (b) if pre-emergency or emergency conditions exist on the utility system; (c) if a hazardous condition relating to the generating facility is observed by the utility's inspection; (d) if the generating facility interferes with the utility's equipment or equipment belonging to other utility customers (including non-utility generating equipment); or (e) if the customer or a party with whom the customer has contracted for ownership and/or operation of the generating facility has tampered with any protective device. The generating facility shall remain disconnected until such time as the utility is satisfied that the endangering condition(s) has been corrected, and the utility shall not be obligated to allow parallel operation of the generating facility during such period. If the utility disconnects the generating facility under this Section 4b, it shall as soon as practicable notify the customer in person or by telephone.
- c. Synchronization: Upon connection, the generating facility shall synchronize with the utility distribution system. Synchronization means that at the Point of Interconnection, the frequency difference shall be less than 0.2 Hz, the voltage difference shall be less than 5%, and the phase angle difference shall be less than 10 degrees.
- d. Voltage Regulation: Unless specifically requested by the utility, the generating facility shall not attempt to control or regulate the utility system voltage while operating in parallel with the utility distribution system.

e. Unintended Islanding: For public and utility personnel safety and to prevent possible damage to customer equipment, the generating facility shall be equipped with protective equipment designed to prevent the generating facility from being connected in parallel with a de-energized utility line. The generating facility must automatically disconnect from the utility distribution system upon loss of utility source, and remain disconnected until the voltage and frequency have stabilized (see Section

4j). Protective device requirements, including direct transfer trip or active anti-islanding scheme, shall be determined on a case-by-case review.

- f. Disconnect for Faults: The generating facility shall be equipped with protective equipment designed to automatically disconnect the generating facility from the utility distribution system for faults on the utility distribution circuit to which it is connected, and remain disconnected until the voltage and frequency have stabilized (see Section 4j).
- g. Voltage Disturbances: The generating facility shall be equipped with protective equipment designed to automatically disconnect the generating facility from the utility distribution system for voltages outside the normal operating range within the clearing time as indicated in the table below, and remain disconnected until the voltage and frequency have stabilized (see Section 4j). The protective equipment shall measure the RMS (root-mean-square) voltage at the Point of Interconnection.

<u>Voltage (% of base voltage)</u>	<u>Voltage (120V base)</u>	<u>Clearing Time</u>
$V < 50\%$	$V < 60$ volts	10 cycles
$50\% \leq V < 88\%$	$60 \text{ volts} \leq V < 106$ volts	120 cycles
$88\% \leq V < 106\%$	$106 \text{ volts} \leq V < 127$ volts	Normal Range
$106\% \leq V < 110\%$	$127 \text{ volts} \leq V < 132$ volts	3 minutes
$110\% \leq V < 120\%$	$132 \text{ volts} \leq V < 144$ volts	60 cycles
$120\% \leq V$	$144 \text{ volts} \leq V$	10 cycles

For generating facilities $\geq 30\text{kW}$, the voltage setpoints and clearing times shall be adjustable to accommodate utility system requirements.

- h. Frequency Disturbances: The generating facility shall be equipped with protective equipment designed to automatically disconnect the generating facility from the utility distribution system when the frequency at the Point of Interconnection deviates outside the normal operating range of 59.3 – 60.5 Hz, and remain disconnected until the voltage and frequency have stabilized (see Section 4j). The frequency settings and time delay can be selected by the utility to provide system security.

For generating facilities less than 30kW, the protective equipment shall disconnect the generating facility within 10 cycles. For generating facilities $\geq 30\text{kW}$, the protective equipment shall: (1) disconnect the generating facility within 10 cycles if the frequency exceeds 60.5 Hz, (2) be capable of time delayed disconnection with adjustable under-frequency settings in the range of 57.0 – 59.3 Hz, and (3) disconnect the generating facility within 10 cycles if the frequency is less than 57.0 Hz.

- i. Inadvertent Energization: The generating facility shall not energize a de-energized utility circuit for any reason. For synchronous generators,

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automatic lockout of the customer circuit breaker or interrupting device shall be required with manual reset. The generating facility may be operated during a utility outage of the distribution system that serves the Point of Interconnection only with an open tie to the utility system which can be locked by utility personnel.

- j. Required Delay on Reconnection: The generating facility shall be equipped with automatic means to prevent reconnection of the generating facility with the utility distribution system until the utility service voltage and frequency are within the utility tariff normal operating ranges and stable for at least 5 minutes, unless earlier directed by the utility.
- k. Loss of Protection: Failure of the generating facility interconnection protection equipment, including loss of control power, shall result in the automatic disconnection of the generating facility from the utility distribution system until such time that the interconnection protection equipment has been restored. Such failure shall initiate a signal to trip a generating facility circuit breaker or shutdown an inverter. Automatic disconnection may be waived by the utility if there is supplemental protection such as direct transfer trip maintained by the utility.
- l. Reclosing Coordination: The generating facility shall be coordinated with the utility system reclosing devices, by disconnecting from the utility distribution system within the first reclose interval and remaining disconnected until the voltage and frequency have stabilized (see Section 4j).
- m. Power Factor: The generating facility shall not adversely impact the power factor at the Point of Interconnection. Synchronous and induction generating facilities shall operate at a power factor ≥ 0.85 (lagging or leading). Inverter-based generating facilities shall operate at a power factor ≥ 0.85 (lagging or leading) when output is greater than 10% of rating in accordance with IEEE Std 929-2000 (or latest version).

Operation outside this range is acceptable provided the reactive power of the generating facility is used to meet the reactive power needs of the customer's internal loads or that reactive power is otherwise provided under utility tariff, and it does not adversely impact the utility system voltage.

- n. Voltage Flicker: Any voltage flicker at the Point of Interconnection caused by the generating facility shall not exceed the limits defined by the "Borderline of Visibility Curve" identified in IEEE Standard 519-1992 "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems" (or latest version). This requirement is

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necessary to minimize the adverse voltage effects upon other utility customers on the utility distribution system.

- o. Harmonics: Harmonic distortion at the Point of Interconnection caused by the generating facility shall not exceed the limits stated in IEEE Standard 519-1992 "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems" (or latest version). The customer is responsible for the installation of any necessary controls or hardware to limit the voltage and current harmonics generated from their generating facility to levels defined in IEEE Standard 519-1992.
- p. Direct Current Injection: The generating facility shall not inject DC current greater than 0.5% of the full rated output current into the utility distribution system at the Point of Interconnection under either normal or abnormal operating conditions. This applies primarily to generating facilities that use an inverter to interconnect with the utility system.
- q. Protection from Electromagnetic Interference (Immunity Protection): The influence of electromagnetic interference (EMI) shall not result in a change in state or misoperation of the generating facility interconnection system.

5. Technology Specific Requirements

- a. Three-Phase Synchronous Generators: The generating facility circuit breakers shall be 3-phase devices with electronic or electromechanical control. The customer shall be responsible for properly synchronizing its generating facility with the utility distribution system by means of either a manual or automatic synchronizing function. Automatic synchronizing is required for all synchronous generators which have an SCCR greater than 5%. For a generating facility whose SCCR exceeds 5%, the customer shall provide protective equipment suitable for detecting loss of synchronism and automatically disconnecting the generating facility from the utility distribution system. Unless otherwise agreed to between the utility and customer, synchronous generators shall automatically regulate power factor, not voltage, while operating in parallel with the utility system.
- b. Induction Generators: Induction generators may be connected and brought up to synchronous speed (as an induction motor) if it can be demonstrated that the initial voltage drop measured at the Point of Interconnection is within the visible flicker limits as defined by IEEE 519-1992 (or latest version). The same requirements also apply to induction generation connected at or near synchronous speed because a similar voltage dip is present due to an inrush magnetizing current. The customer shall submit number of starts per specific time period and maximum

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starting kVA draw data for the utility to verify that the voltage dip due to starting is within the visible flicker limits and does not degrade the normal voltage provided by the utility.

Induction generators do not require separate synchronizing equipment. Starting or rapid load fluctuations on induction generators can adversely impact the utility's system voltage. Corrective step-switched capacitors or other techniques may be necessary. These measures can, in turn, cause ferroresonance. If these measures (additional capacitors) are installed on the customer's side of the Point of Interconnection, the utility will review these measures and may require the customer to install additional protective relaying equipment.

- c. Inverter Systems: Direct current generators and non-power (i.e. other than 60 Hertz) alternating current generators can only be installed in parallel with the utility distribution system using a non-islanding synchronous inverter. The design shall comply with the requirements of IEEE Std 929-2000 (or latest version) such that the synchronous inverter will automatically disconnect upon a utility system interruption.

Self-commutated inverters of the utility-interactive type shall synchronize to the utility. Inverters capable of stand-alone operation shall not attempt to control the voltage while operating in parallel with the utility distribution system. Line-commutated, thyristor-based inverters are not recommended and will require additional study to determine harmonic and reactive power requirements. All interconnected inverter systems shall comply with the harmonic current limits of IEEE Std 519-1992 (or latest version).

6. Protection, Synchronizing, and Control Requirements

- a. Protection Requirements: The generating facility shall, at a minimum, provide adequate protective devices which include over/under voltage trip, over/under frequency trip, reverse power relay (for non-export generating facilities), and a means for automatically disconnecting the generating facility from the utility distribution system whenever a protective device initiates a trip. Additional protective devices may be required based on a case-by-case review. Photovoltaic generating systems are to follow the guidelines set by IEEE 929-2000 and UL 1741 standards (or latest versions). Typical equipment and protective device requirements for large synchronous, induction, and inverter generators are illustrated in Figures 1, 2, and 3 respectively in Appendix A.

All protective devices (described in this document) for generating facilities $\geq 30\text{kW}$ shall be utility-grade (see Definition for "Utility-Grade Protective Equipment") except for photovoltaic generating systems which shall comply with IEEE 929-2000 and UL-1741 standards (or latest versions). The generating facility shall be responsible for identifying the specific models of their protective devices.

- b. Review of Design Drawings: The following engineering drawings/documents are required for review and approval by the utility prior to construction of the generating facility interconnection. **Prior to being submitted to the utility, all drawings/documents shall be approved by a Professional Electrical Engineer registered in the State of Hawaii for generating facilities $\geq 30\text{kW}$. That approval shall be indicated by the presence of the Engineer's Professional seal on all drawings and documents.**
- A single-line diagram, relay list and trip scheme of the generating facility, which identifies the Point of Interconnection, circuit breakers, relays, switches, synchronizing equipment, monitoring equipment, and control and protective devices and schemes.
 - A three-line diagram which shows the Point of Interconnection, potential transformer (PT) and current transformer (CT) ratios, and details of the generating facility configuration, including relays, meters and test switches. (Not required for generating facilities $< 30\text{kW}$).

APPENDIX A

Typical Equipment and Protective Device Requirements for
Large Synchronous, Induction, and Inverter Generators

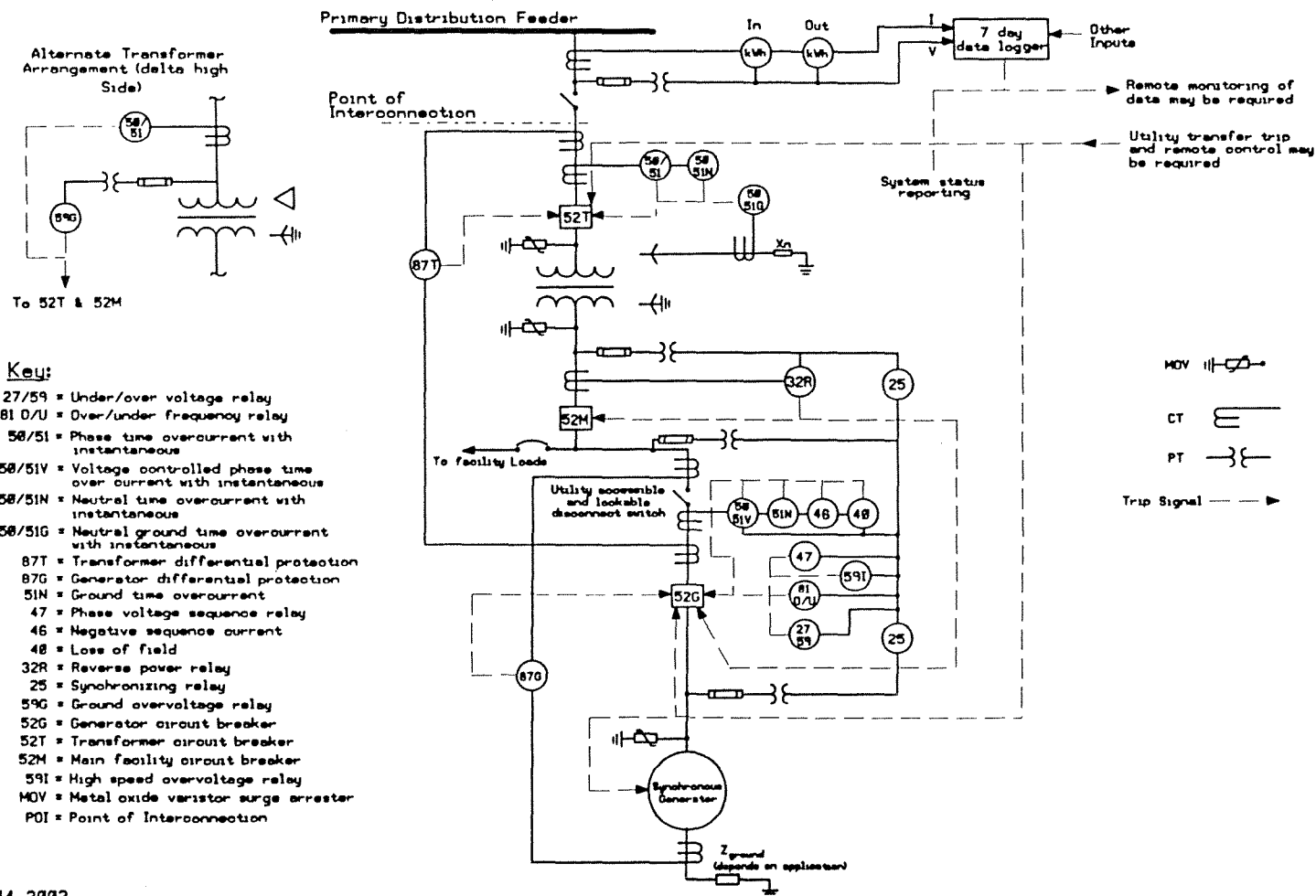
HAWAIIAN ELECTRIC COMPANY, INC.

Transmittal 02-01, dated January 15, 2002

Figure 1

Large Synchronous Generator (Non-export)

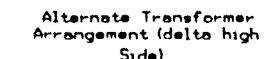
Typical Equipment and Protective Device Requirements



January 14, 2002

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Figure 2



To 52T & 52M

Key:

- 27/59 = Under/over voltage relay
- 81 0/U = Over/under frequency relay
- 58/51 = Phase time overcurrent with instantaneous
- 58/51V = Voltage controlled phase time over current with instantaneous
- 58/51N = Neutral time overcurrent with instantaneous
- 58/51G = Neutral ground time overcurrent with instantaneous
- 87T = Transformer differential protection
- 87G = Generator differential protection
- 51N = Ground time overcurrent
- 47 = Phase voltage sequence relay
- 46 = Negative sequence current
- 32R = Reverse power relay
- 15 = Speed matching relay
- 59G = Ground overvoltage relay
- 52G = Generator circuit breaker
- 52T = Transformer circuit breaker
- 52M = Main facility circuit breaker
- 59I = High speed overvoltage relay
- MOV = Metal oxide varistor surge arrester

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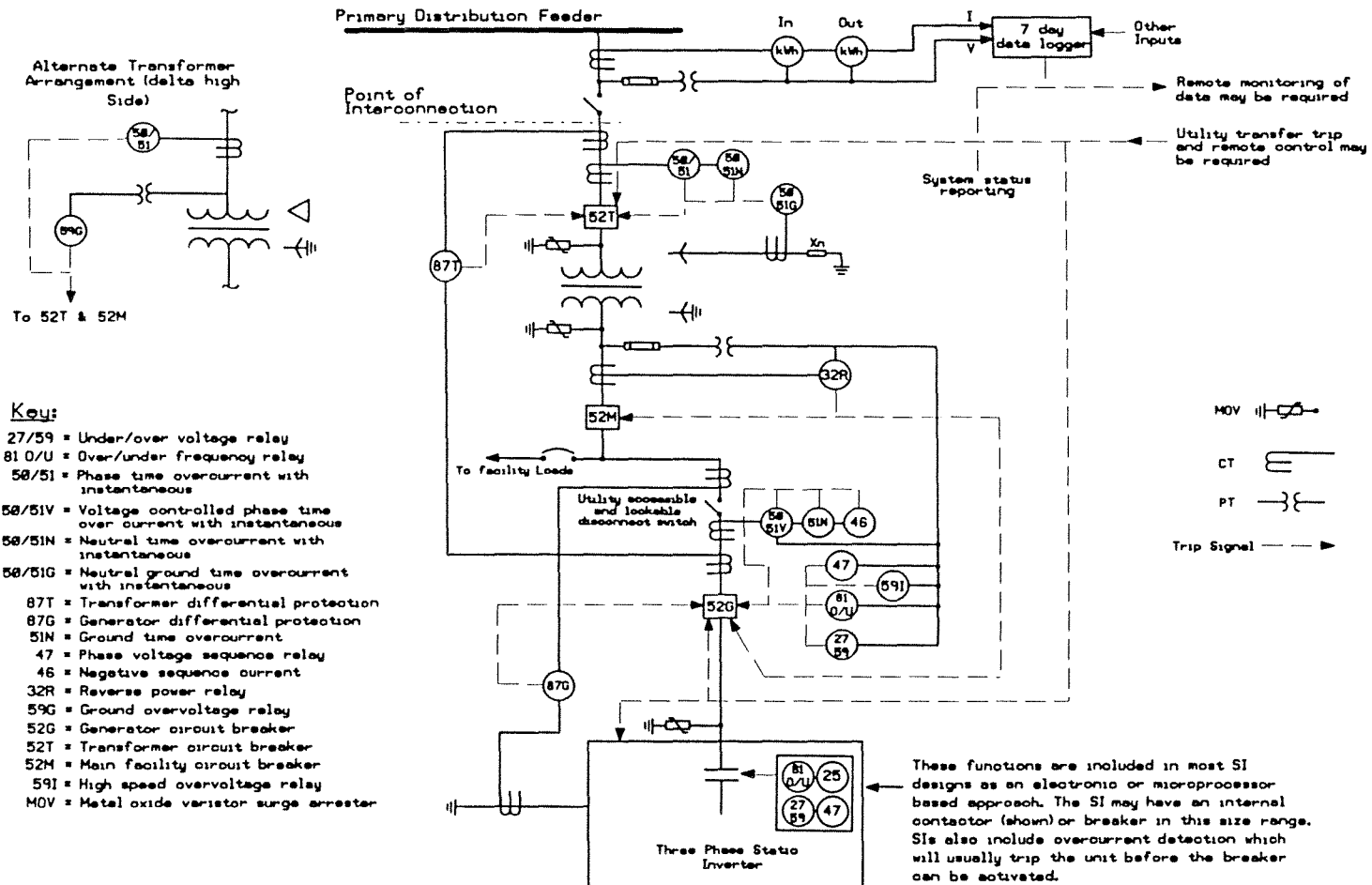
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Figure 3

Large Static Inverter (Non-export)

Typical Equipment and Protective Device Requirements



January 14, 2002

APPENDIX II
STANDARD INTERCONNECTION AGREEMENT

THIS AGREEMENT ("Agreement") is made this _____ day of _____, 20__, by and between _____, hereinafter called the Company and _____, hereinafter called the Customer.

WHEREAS, the Customer is the recipient of electric service in accordance with the Company's Tariff; and

WHEREAS, the Customer and/or a third party is the owner and/or operator of a generating facility ("Facility"), as identified in Exhibit A and defined in Section 3 of this Agreement; and

WHEREAS, the Customer desires to interconnect the Facility in parallel with the Company's system upon the terms and conditions set forth herein.

NOW, THEREFORE, in consideration of the premises and the respective promises herein, the Company and the Customer hereby agree as follows:

1. Scope Of Agreement: This Agreement relates solely to the conditions under which the Company and the Customer agree that the Facility may be interconnected to and operated in parallel with the Company's system.
2. Parallel Operation: The Facility may interconnect and operate in parallel with the Company's system in accordance with the terms and conditions of this Agreement.
3. Facility:
 - (a) For the purposes of this Agreement, the "Facility" is defined as the equipment and devices, and associated appurtenances, owned by the Customer and/or a third party, which produce electric energy for use by the Customer and are to be interconnected and operated in parallel with the Company's system.
 - (b) The Customer shall furnish, install, operate and maintain, at its cost, the interconnection facilities (such as circuit breakers, relays, switches, synchronizing equipment, monitoring equipment, and control and protective devices and

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schemes) identified in Exhibit B hereto ("Customer Interconnection Facilities").

- (c) The point of interconnection is shown on the single-line diagram and three-line diagram (provided by the Customer and reviewed by the Company) which are attached to Exhibit B (provided that the three-line diagram is not required if the Facility's capacity is less than 30 kW).
 - (d) The Customer agrees to test the Facility, to maintain operating records, and to follow such operating procedures, as may be specified by the Company to protect the Company's system from damages resulting from the parallel operation of the Facility, including such testing, records and operating procedures as more fully described in Exhibit B attached hereto and made a part hereof.
 - (e) The Company may inspect the Facility, as more fully described in Exhibit B.
4. Interconnection Facilities Owned by the Company: The Company agrees to furnish, install, operate and maintain such interconnection facilities on its side of the point of interconnection with the Facility as required for parallel operation with the Facility and as more fully described in Exhibit C attached hereto and made a part hereof ("Company Interconnection Facilities"). All such interconnection facilities shall be the property of the Company. Where portions of the Company Interconnection Facilities are located on the Customer's premises, the Customer shall provide, at no expense to the Company, a suitable location for and access to all such equipment. If a 120/240 Volt power source or sources are required, the Customer shall provide these at no expense to the Company.
5. Customer Payments: The Customer agrees to pay to the Company a non-refundable contribution for the Company's investment in the interconnection facilities described in Exhibit C, subject to the terms and conditions included in Exhibit C, and to pay for other interconnection costs. The interconnection costs will not include the cost of an initial technical screening of the impact of the Facility on the Company's system, but will include the actual cost (or such lesser amount as the Company may specify to facilitate the processing of interconnection requests for similarly situated facilities) of a case-by-case review and/or detailed interconnection requirements study for the Facility.

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6. Commencement of Producing Energy in Parallel: After this Agreement is executed, and the Customer Interconnection Facilities and the Company Interconnection Facilities are completed, the Facility may be operated in parallel with the Company's system, provided that the Customer has satisfied the conditions in Section 3 of Exhibit B of this Agreement.
7. Incidental Deliveries of Energy: The Company shall have no duty under this Agreement to account for, pay for, deliver, or return in kind any energy produced by the Facility and delivered into the Company's system. The meter for service received from the Company shall be ratcheted to prevent reverse registration.
8. Continuity of Service: Upon providing such notice, if any, as may be reasonable under the circumstances, the Company may require the Customer to temporarily disconnect the Facility from the Company's system (a) when necessary for the Company to construct, install, maintain, repair, replace, remove, investigate, test or inspect any of its equipment or other customers' equipment or any part of its system; or (b) if the Company determines that such disconnection is necessary because of a system emergency, forced outage, operating conditions on its systems, or compliance with good engineering practices. The Company shall take reasonable steps to minimize the number and duration of such disconnections. The Company may disconnect the Customer from the Company's system for failure by the Customer to disconnect the Facility under this Section 8, until such time that the Company's work or the system condition has been corrected and the normal system condition has been restored.
9. Personnel and System Safety: Notwithstanding any other provisions of this Agreement, the Company may disconnect the Facility from the Company's system, without prior notice to the Customer, (a) to eliminate conditions that constitute a potential hazard to the Company's personnel or the general public; (b) if pre-emergency or emergency conditions exist on the Company system; (c) if a hazardous condition relating to the Facility is observed by the Company's inspection; (d) if the Facility interferes with the Company's equipment or equipment belonging to other customers of the Company (including non-utility generating equipment); or (e) if the Customer and/or owner and/or operator of the Facility has tampered with any protective device. The Facility shall remain disconnected until such time as the Company is satisfied that the endangering condition(s) has been corrected, and the Company shall not be obligated to allow

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parallel operation of the Facility during such period. If the Company disconnects the Facility under this Section 9, it shall as soon as practicable notify the Customer in person or by telephone.

10. Transmission Service Not Provided with Interconnection: Interconnection with the Company's system under this Agreement does not provide the Customer any rights to utilize the Company's system for the transmission or distribution of electric power.
11. Prevention of Interference: The Customer shall not operate equipment that superimposes a voltage or current upon the Company's system that interferes with the Company's operations, service to the Company's customers, or the Company's communication facilities. Such interference shall include, but not be limited to, overcurrent, voltage imbalance, and abnormal waveforms. If such interference occurs, the Customer must diligently pursue and take corrective action at its own expense after being given notice and reasonable time to do so by the Company. If the Customer does not take timely corrective action, or continues to operate the equipment causing interference without restriction or limit, the Company may, without liability, disconnect the Customer's equipment from the Company's system.
12. Location of Metering: Where Company-owned metering is located on the Customer's premises, the Customer shall provide, at no expense to the Company, a suitable location for and access to all such metering.
13. Design Reviews and Inspections: The Company's review and authorization to allow the Facility to interconnect and operate in parallel with the Company's system shall not be construed as confirming or endorsing the Facility's design or as warranting the Facility's safety, durability or reliability. The Company shall not, by reason of such review or lack of review, be responsible for the equipment, including but not limited to, the safety, strength, adequacy, durability, reliability, performance, or capacity of such equipment.
14. Permits, Approvals, and Licenses: The Customer shall obtain, at its expense, any and all authorizations, approvals, permits, and licenses required for the construction and operation of the Facility and the interconnection with the Company's system, including but not limited to environmental permits, building permits, rights-of-way, or easements.

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15. Term: This Agreement shall become effective upon execution by the two parties and shall remain in effect for an initial term of one year and shall continue in effect from month-to-month thereafter, unless terminated by any party upon thirty (30) days prior written notice to the other party. Notwithstanding any other provisions of this Agreement, the Company may terminate this Agreement if the Facility is removed from permanent service.
16. Termination: In addition to the termination provisions in Section 15, any party may, by giving the other party at least thirty (30) days prior written notice, terminate this Agreement in the event that the other party is in default of any of the material terms and conditions of this Agreement. The terminating party shall specify in the notice the basis for the termination and shall provide a reasonable opportunity to cure the default.
17. Disconnection and Survival of Obligations: Upon termination of this Agreement the Facility shall be disconnected from the Company's system. The termination of this Agreement shall not relieve the parties of their liabilities and obligations, owed or continuing at the time of the termination.
18. Indemnification:
 - (a) The Customer shall indemnify, defend and hold harmless the Company and its officers, directors, agents and employees, from and against all liabilities, damages, losses, fines, penalties, claims, demands, suits, costs and expenses (including reasonable attorney's fees and expenses) to or by third persons, including the Company's employees or subcontractors, for injury or death, or for injury to property, arising out of the actions or inactions of the Customer (or those of anyone under its control or on its behalf) with respect to its obligations under this Agreement, and/or arising out of the installation, operation and maintenance of the Facility and/or the Customer Interconnection Facilities, except to the extent that such injury, death or damage is attributable to the gross negligence or intentional act or omission of the Company or its officers, directors, agents or employees.
 - (b) The Company shall indemnify, defend and hold harmless the Customer, and its officers, directors, agents and employees, from and against all liabilities, damages, losses, fines, penalties, claims, demands, suits, costs and expenses (including reasonable attorney's fees and expenses) to or by third persons, including the Customer's employees or subcontractors, for injury or death,

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or for injury to property, arising out of the actions or inactions of the Company (or those of anyone under its control or on its behalf) with respect to its obligations under this Agreement, and/or arising out of the installation, operation and maintenance of the Company Interconnection Facilities, except to the extent that such injury, death or damage is attributable to the gross negligence or intentional act or omission of the Customer or its officers, directors, agents or employees.

- (c) Nothing in this Agreement shall create any duty to, any standard of care with reference to, or any liability to any person not a party to it.

19. Insurance: The Customer shall, at its own expense and during the term of the Agreement and any other time that the Facility is interconnected with the Company's system, maintain in effect with a responsible insurance company authorized to do insurance business in Hawaii, the following insurance that will protect the Customer and the Company with respect to the Facility, the Facility's operations, and the Facility's interconnection with the Company's system:

A commercial general liability policy, covering bodily injury and property damage combined single limit of at least the following amounts based on the nameplate rating of the generator as indicated in Exhibit A, Section 3, for any occurrence.

Amount	Generator Nameplate Rating
\$2,000,000	Greater than 100 kW
\$1,000,000	Greater than 20 kW and less than or equal to 100 kW
\$500,000	Greater than 10 kW and less than or equal to 20 kW
\$100,000	Less than or equal to 10 kW

The Customer has responsibility to determine if higher limits are desired and purchased. Said insurance shall name the Company, its directors, officers, agents, and employees as additional insureds, shall include contractual liability coverage for written contracts and agreements including this Agreement, shall include provisions stating that the insurance will respond to claims or suits by additional insureds against the Customer or any other insured thereunder, and shall be non-cancelable and non-alterable without thirty (30) days prior written notice to the Company. "Claims made" policies are not acceptable, unless the Customer agrees to maintain coverage in full effect at all

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times during the term of this Agreement and for THREE (3) years thereafter. The adequacy of the coverage afforded by the required insurance shall be subject to review by the Company from time to time, and if it appears in such review that risk exposures require an increase in the coverages and/or limits of this insurance, the Customer shall make such increase to that extent and any increased costs shall be borne by the Customer. The insurance required hereunder shall provide that it is primary with respect to the Customer and the Company. The Customer shall provide evidence of such insurance, including insurer's acknowledgement that coverage applies with respect to this Agreement, by providing certificates of insurance to the Company within 30 days of any change. Initially, certificates of insurance must be provided to the Company prior to executing the Agreement and any parallel interconnection. The Customer's indemnity and other obligations shall not be limited by the foregoing insurance requirements. Any deductible shall be the responsibility of the Customer.

20. Force Majeure: If the Company shall be wholly or partially prevented from performing any of its obligations under this Agreement by reason of any cause reasonably beyond its exclusive control and not attributed to its neglect, then and in any such event, the Company shall be excused from whatever performance is prevented by such event to the extent so prevented, and the Company shall not be liable for any damage or loss resulting therefrom.
21. Warranties: The Company and the Customer each represents and warrants respectively that:
 - (a) It has all necessary right, power and authority to execute, deliver and perform this Agreement.
 - (b) The execution, delivery and performance of this Agreement by it will not result in a violation of any law or regulation of any governmental authority, or conflict with, or result in a breach of, or cause a default under, any agreement or instrument to which such party is also a party or by which it is bound.
22. Good Engineering Practice:
 - (a) Each party agrees to install, operate and maintain its respective equipment and facilities and to perform all obligations required to be performed by such party under this

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Agreement in accordance with good engineering practice in the electric industry and with applicable laws, rules, orders and tariffs.

- (b) Wherever in this Agreement and the attached Exhibits the Company has the right to give specifications, determinations or approvals, such specifications, determinations or approvals shall be given in accordance with the Company's standard practices, policies and procedures.

23. Miscellaneous:

- (a) Amendments. Any amendment or modification of this Agreement or any part hereof shall not be valid unless in writing and signed by the parties. Any waiver hereunder shall not be valid unless in writing and signed by the party against whom waiver is asserted.
- (b) Binding Effect. This Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective successors, legal representatives, and permitted assigns.
- (c) Notices. Any written notice provided hereunder shall be delivered personally or sent by registered or certified first class mail, with postage prepaid, to the other party at the following addresses:

Company: _____

Attn: _____

Customer: The mailing address listed in Exhibit A attached hereto.

Notice sent by mail shall be deemed to have been given on the date of actual delivery or at the expiration of the fifth day after the date of mailing, whichever is earlier. Any party hereto may change its address for written notice by giving written notice of such change to the other party hereto.

- (d) Effect of Section and Exhibit Headings. The headings or titles of the several sections and exhibits hereof are for convenience of reference and shall not affect the

HAWAIIAN ELECTRIC COMPANY, INC.

construction or interpretation of any provision of this Agreement.

- (e) Relationship of Parties. Nothing in this Agreement shall be deemed to constitute any party hereto as partner, agent or representative of the other party or to create any fiduciary relationship between the parties.
- (f) Entire Agreement. This Agreement constitutes the entire understanding and agreement between the Company and the Customer.
- (g) Limitations. Nothing in this Agreement shall limit the Company's ability to exercise its rights or expand or diminish its liability with respect to the provision of electrical service pursuant to the Company's Tariff as filed with the State of Hawaii Public Utilities Commission ("PUC"), or the PUC's Standards for Electric Utility Service in the State of Hawaii, which currently are included in the PUC's General Order Number 7, as either may be amended from time to time.
- (h) Governing Law and Regulatory Authority. This Agreement was executed in the State of Hawaii and must in all respects be governed by, interpreted, construed, and enforced in accordance with the laws thereof. This Agreement is subject to, and the parties' obligations hereunder include, operating in full compliance with all valid, applicable federal, state, and local laws or ordinances, and all applicable rules, regulations, orders of, and tariffs approved by, duly constituted regulatory authorities having jurisdiction.
- (i) Multiple Counterparts. This Agreement may be executed in two or more counterparts, each of which is deemed an original but all constitute one and the same instrument.

HAWAIIAN ELECTRIC COMPANY, INC.

Transmittal 02-01, dated January 15, 2002

SHEET NO. 34C-10
Effective February 15, 2002

IN WITNESS WHEREOF, the Company and the Customer have executed this Agreement as of the day and year first above written.

By _____
Its

"Company"

By _____
Its

"Customer"

HAWAIIAN ELECTRIC COMPANY, INC.

Transmittal 02-01, dated January 15, 2002

EXHIBIT A

DESCRIPTION OF CUSTOMER'S GENERATING FACILITY

Section 1, Applicant Information

Customer

Name: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Telephone (Daytime): Area Code _____ Number _____ (Evening) Area Code _____ Number _____

Facility Location (if different from above): _____

Owner (if different from Customer)

Name: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Telephone (Daytime): Area Code _____ Number _____ (Evening) Area Code _____ Number _____

Operator (if different from Customer)

Name: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Telephone (Daytime): Area Code _____ Number _____ (Evening) Area Code _____ Number _____

Section 2, Generator Qualifications

Is the generator a Qualifying Facility as defined under Subpart B, Section 201 of the Federal Energy Regulatory Commission's regulations per the Public Utility Regulatory Policies Act of 1978, or the PUC's Standards for Small Power Production and Cogeneration (Hawaii Administrative Rules Title 6, Chapter 74)?

☐ Yes ☐ No

Is Generator powered from a Nonfossil Fuel Source?

☐ Yes ☐ No

Type of Qualifying Facility or Nonfossil Fuel
Source (if applicable):

☐ Solar ☐ Wind ☐ Hydro
☐ Biomass ☐ Geothermal

Other generator energy source: ☐ Diesel ☐ Other Fuel Oil ☐ Other: _____

Maximum Site Load without Generation: _____ kW Maximum Generating Capability: _____ kW

Minimum Site Load without Generation: _____ kW Maximum Export: _____ kW

Section 3. Generator Technical Information

Type of Generator: ☐ Synchronous ☐ Induction ☐ DC Generator or Solar with Inverter

Generator (or solar collector) Manufacturer, Model Name & Number: _____
(A copy of Generator Nameplate and Manufacturer's Specification Sheet may be substituted)

_____ Nameplate Rating in kW: _____
Operating Power Factor: _____

Inverter Manufacturer, Model Name & Number (if used): _____
(A copy of Inverter Nameplate and Manufacturer's Specification Sheet may be substituted)

_____ Rating in kW: _____
Operating Power Factor: _____

Number of Starts Per Day: _____ Maximum Starting kVA: _____

Generator Grounding Method:

☐ Effectively Grounded ☐ Resonant Grounded
☐ Low-Inductance Grounded ☐ High-Resistance Grounded
☐ Low-Resistance Grounded ☐ Ungrounded

Generator Characteristic Data (for rotating machines):
(Not needed if Generator Nameplate and Manufacturer's Specification Sheet are provided)

Direct Axis Synchronous Reactance, X_d : _____ P.U. Negative Sequence Reactance: _____ P.U.
Direct Axis Transient Reactance, X'_d : _____ P.U. Zero Sequence Reactance: _____ P.U.
Direct Axis Subtransient Reactance, X''_d : _____ P.U. KVA Base: _____
Inertia Constant, H: _____ P.U.
Excitation Response Ratio: _____
Direct Axis Open-Circuit Transient Time Constant, T'_{do} : _____ Seconds
Direct Axis Open-Circuit Subtransient Time Constant, T''_{do} : _____ Seconds

Fault Current Contribution of Generator: _____ Amps

Section 4. Interconnecting Equipment Technical Data

Will an interposing transformer be used between the generator and the point of interconnection? ☐ Yes ☐ No

Transformer Data (if applicable, for Customer Owned Transformer):
(A copy of transformer Nameplate and Manufacturer's Test Report may be substituted)

Size: _____ KVA. Transformer Primary: _____ Volts ☐ Delta ☐ Wye ☐ Wye Grounded

Transformer Secondary: _____ Volts ☐ Delta ☐ Wye ☐ Wye Grounded

Transformer Impedance: _____ % on _____ KVA Base

Transformer Fuse Data (if applicable, for Customer Owned Fuse):
(Attach copy of fuse manufacturer's Minimum Melt & Total Clearing Time-Current Curves)

At ☐ Primary Voltage ☐ Secondary Voltage

Manufacturer: _____ Type: _____ Size: _____ Speed: _____

Transformer Protection (if not fuse):

Please describe: _____

Interconnecting Circuit Breaker (if applicable):
(A copy of circuit breaker's Nameplate and Specification Sheet may be substituted)

Manufacturer: _____ Type: _____
Continuous Load Rating: _____ Interrupting Rating: _____ Trip Speed: _____
(Amps) (Amps) (Cycles)

Circuit Breaker Protective Relays (if applicable):
(Enclose copy of any proposed Time-Overcurrent Coordination Curves)

Manufacturer: _____	Type: _____	Style/Catalog No.: _____	Proposed Setting: _____
Manufacturer: _____	Type: _____	Style/Catalog No.: _____	Proposed Setting: _____
Manufacturer: _____	Type: _____	Style/Catalog No.: _____	Proposed Setting: _____
Manufacturer: _____	Type: _____	Style/Catalog No.: _____	Proposed Setting: _____
Manufacturer: _____	Type: _____	Style/Catalog No.: _____	Proposed Setting: _____

Current Transformer Data (if applicable):
(Enclose copy of Manufacturer's Excitation & Ratio Correction Curves)

Manufacturer: _____	Type: _____	Accuracy Class: _____	Proposed Ratio Connection: _____ /5
Manufacturer: _____	Type: _____	Accuracy Class: _____	Proposed Ratio Connection: _____ /5

Generator Disconnect Switch:

A generator disconnect device (isolation device) must be installed with features as described in the "HECO, HELCO, MECO Distributed Generating Facility Interconnection Standards, Technical Requirements" as set forth in Rule No. 14 (Paragraph H.1) of the Company's tariff, and which is accessible to Company.

Manufacturer: _____ Type: _____ Catalog No.: _____ Rated Volts: _____ Rated Amps: _____

Single or 3 Phase: _____ Mounting Location: _____

Section 5, General Technical Information

Enclose copy of site single-line diagram showing configuration and interconnection of all equipment, current and potential circuits and protection and control schemes.

Is Single-Line Diagram Enclosed? Yes ☐

Enclose copy of site relay list and trip scheme, which shall include all protection, synchronizing and auxiliary relays that are required to operate the Facility in a safe and reliable manner.

Are Relay List and Trip Scheme Enclosed? Yes ☐

Enclose copy of site three-line diagram (if the Facility's capacity is greater than or equal to 30 kW) showing potential transformer and current transformer ratios, and details of the Facility's configuration, including relays, meters, and test switches.

Is Three-Line Diagram Enclosed? Yes ☐

Section 6, Installation Details

Installing Electrical Contractor: _____ Firm: _____ License No.: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Telephone: Area Code: _____ Number: _____

Installation Date: _____ Interconnection Date: _____

Supply certification that the generating system has been installed and inspected in compliance with the local Building/Electrical code of the county of _____.

Signed (Inspector): _____ Date: _____
(In lieu of signature of Inspector, a copy of the final inspection certificate may be attached)

Section 7, Generator/Equipment Certification

Generating systems that utilize inverter technology must be compliant with *Institute of Electrical and Electronics Engineers IEEE Std 929* and *Underwriters Laboratories UL 1741* in effect at the time this Agreement is executed. Generating systems that use a rotating machine must be compliant with applicable National Electrical Code, Underwriters Laboratories, and Institute of Electrical and Electronics Engineers standards and rules and orders of the Hawaii Public Utilities Commission in effect at the time this Agreement is executed. **By signing below, the Applicant certifies that the installed generating equipment meets the appropriate preceding requirement(s) and can supply documentation that confirms compliance.**

Signed (Customer): _____ Date: _____

Section 8, Insurance

Insurance Carrier: _____

EXHIBIT B

FACILITY OWNED BY THE CUSTOMER OR THIRD PARTY OWNER

1. Facility

- a. Compliance with laws. The Facility, Facility design, and Facility design drawings shall meet all applicable national, state, and local laws, rules, regulations, orders, and construction and safety codes.
- b. Avoidance of adverse system conditions. The Facility shall be designed, installed, operated and maintained so as to prevent or protect against adverse conditions on the Company's system that can cause electric service degradation, equipment damage, or harm to persons, such as:
 - (i) Unintended islanding.
 - (ii) Inadvertent and unwanted re-energization of a Company dead line or bus.
 - (iii) Interconnection while out of synchronization.
 - (iv) Overcurrent.
 - (v) Voltage imbalance.
 - (vi) Ground faults.
 - (vii) Generated alternating current frequency outside of permitted safe limits.
 - (viii) Voltage outside permitted limits.
 - (ix) Poor power factor or reactive power outside permitted limits.
 - (x) Abnormal waveforms.
- c. Specification of protection, synchronizing and control requirements. The Customer shall provide the design drawings, operating manuals, manufacturer's brochures/instruction manual and technical specifications, manufacturer's test reports, bill of material, protection and synchronizing relays and settings, and protection,

synchronizing, and control schemes for the Facility to the Company for its review, and the Company shall have the right to specify the protection and synchronizing relays and settings, and protection, synchronizing and control schemes that affect the reliability and safety of operation and power quality of the Company's system with which the Facility is interconnected ("Facility Protection Devices/Schemes"). After the implementation of the protection and synchronizing relays and settings, and protection, synchronizing and control schemes, the Company may require changes in the protection and synchronizing relays and settings, and protection, synchronizing and control schemes, when required by the Company's system operations, at the Company's expense. After the implementation of the protection and synchronizing relays and settings, and protection, synchronizing and control schemes, the Company may require changes in the protection and synchronizing relays and settings, and protection, synchronizing and control schemes, when required by the Facility's operations, at the Customer's expense.

- d. Facility protection. The Customer is solely responsible for providing adequate protection for the Facility.
- e. Customer Interconnection Facilities.
 - (i) The Customer shall furnish, install, operate and maintain interconnection facilities (such as circuit breakers, relays, switches, synchronizing equipment, monitoring equipment, and control and protective devices and schemes) designated by or acceptable to the Company as suitable for parallel operation of the Facility with the Company's system ("Customer Interconnection Facilities"). Such facilities shall be accessible at all times to authorized Company personnel.
 - (ii) The Customer shall comply with the "HECO, HELCO, MECO Distributed Generating Facility Interconnection Standards, Technical Requirements" ("Interconnection Standards"), as set forth in Rule No. 14, Paragraph H.1 of the Company's tariff. If a conflict exists between the Interconnection Standards and this Agreement, this Agreement shall control.
 - (iii) A 1) single-line diagram, 2) relay list and trip scheme of the Facility, 3) Facility Equipment List, and 4) three-line diagram (if the Facility's capacity is

greater than or equal to 30 kW), which identify the circuit breakers, relays, switches, synchronizing equipment, monitoring equipment, and control and protective devices and schemes, shall, after having obtained prior consent from the Company, be attached to this Exhibit B and made a part hereof at the time the Agreement is signed. The single-line diagram shall include pertinent information regarding operation, protection, synchronizing, control, monitoring and alarm requirements. The single-line diagram and three-line diagram shall expressly identify the point of interconnection of the Facility to the Company's system. The relay list and trip scheme shall include all protection, synchronizing and auxiliary relays that are required to operate the Facility in a safe and reliable manner. The three-line diagram shall show potential transformer and current transformer ratios, and details of the Facility's configuration, including relays, meters, and test switches.

- f. Approval of Design Drawings. If the Facility's capacity is greater than or equal to 30 kW, the single-line diagram, relay list and trip scheme of the Facility, and three-line diagram shall be approved by a Professional Electrical Engineer registered in the State of Hawaii prior to being submitted to the Company. Such approval shall be indicated by the engineer's professional seal on all drawings and documents.

2. Verification Testing.

- a. Upon initial parallel operation of the Facility, or any time interface hardware or software is changed, a verification test shall be performed. A licensed professional engineer or otherwise qualified individual shall perform verification testing in accordance with the manufacturer's published test procedure. Qualified individuals include professional engineers, factory trained and certified technicians, and licensed electricians with experience in testing protective equipment. The Company reserves the right to witness verification testing or require written certification that the testing was performed.
- b. Verification testing shall be performed every four years. All verification tests prescribed by the manufacturer shall be performed. If wires must be removed to perform certain tests, each wire and each terminal shall be clearly and

permanently marked. The Customer shall maintain verification test reports for inspection by the Company.

- c. Single-phase inverters rated 10 kVA and below (if any) shall be verified once per year as follows: once per year the Customer shall operate the load break disconnect switch and verify the Facility automatically shuts down and does not reconnect with the Company's system until the Company's system continuous normal voltage and frequency have been maintained for a minimum of 5 minutes. The Customer shall maintain a log of these operations for inspection by the Company.
- d. Any system that depends upon a battery for trip power shall be checked once per month for proper voltage. Once every four (4) years the battery shall either be replaced or have a discharge test performed. The Customer shall maintain a log of these operations for inspection by the Company.
- e. Tests and battery replacements as specified in this section 2 of Exhibit B shall be at the Customer's expense.

3. Inspection of the Facility.

- a. The Company may, in its discretion and upon reasonable notice, observe the construction of the Facility (including but not limited to relay settings and trip schemes) and the equipment to be installed therein.
- b. Within fourteen days after receiving a written request from the Customer to begin producing electric energy in parallel with the Company's system, the Company may inspect the Facility (including but not limited to relay settings and trip schemes) and observe the performance of the verification testing. The Company may accept or reject the request to begin producing electric energy based upon the inspection or verification test results.
- c. If the Company does not perform an inspection of the Facility (including but not limited to relay settings and trip schemes) and observe the performance of verification testing within the fourteen-day period, the Customer may begin to produce energy after certifying to the Company that the Facility has been tested in accordance with the verification testing requirements and has successfully completed such tests. After receiving the certification, the Company may conduct an inspection of the Facility (including but not limited to relay settings and trip

schemes) and make reasonable inquiries of the Customer, but only for purposes of determining whether the verification tests were properly performed. The Customer shall not be required to perform the verification tests a second time, unless irregularities appear in the verification test report or there are other objective indications that the tests were not properly performed in the first instance.

- d. The Company may, in its discretion and upon reasonable notice, inspect the Facility (including but not limited to relay settings and trip schemes) and its operations (including but not limited to the operation of control, synchronizing, and protection schemes) after the Facility commences operations.

4. Operating Records and Procedures.

- a. The Company may require periodic reviews of the maintenance records, and available operating procedures and policies of the Facility.
- b. The Customer must separate the Facility from the Company's system whenever requested to do so by the Company's System Operator pursuant to Sections 8, 9, and 11 of the Agreement. It is understood and agreed that at times it may not be possible for the Company to accept electric energy due to temporary operating conditions on the Company's system, and these periods shall be specified by the Company's System Operator. Notice shall be given in advance when these are scheduled operating conditions.
- c. Logs shall be kept by the Customer for information on unit availability including reasons for planned and forced outages; circuit breaker trip operations, relay operations, including target initiation and other unusual events. The Company shall have the right to review these logs, especially in analyzing system disturbance.

5. Changes to the Facility, Operating Records, and Operating Procedures.

- a. The Customer agrees that no material changes or additions to the Facility as reflected in the single-line diagram, relay list and trip scheme of the Facility, Facility Equipment List, and three-line diagram (if the Facility's capacity is greater than or equal to 30 kW), shall be made without having obtained prior written consent from the Company.

- b. As a result of the observations and inspections of the Facility (including but not limited to relay settings and trip schemes) and the performance of the verification tests, if any changes in or additions to the Facility, operating records, and operating procedures and policies are required by the Company, the Company shall specify such changes or additions to the Customer in writing, and the Customer shall, as soon as practicable, but in no event later than thirty (30) days after receipt of such changes or additions, respond in writing, either noting agreement and action to be taken or reasons for disagreement. If the Customer disagrees with the Company, it shall note alternatives it will take to accomplish the same intent, or provide the Company with a reasonable explanation as to why no action is required by good engineering practice.

(Additional terms and provisions to be added as necessary. Note: This parenthetical phrase should be deleted when the agreement is finalized.)

Facility Equipment List

The Facility shall include the following equipment:

(Specific items to be added as necessary. Note: This parenthetical phrase should be deleted when the agreement is finalized.)

(This Facility Equipment List, together with the single-line diagram, relay list and trip scheme, and three-line diagram (if the Facility's capacity is greater than or equal to 30 kW), should be attached behind Exhibit B. Note: This parenthetical phrase should be deleted when the agreement is finalized.)

EXHIBIT C

INTERCONNECTION FACILITIES OWNED BY THE COMPANY

1. Description of Company Interconnection Facilities

The Company will purchase, construct, own, operate and maintain all interconnection facilities required to interconnect the Company's system with the Facility at ___ volts, up to the point of interconnection.

The Company Interconnection Facilities, for which the Customer agrees to pay, include:

[Need to specify the interconnection facilities. If no interconnection facilities, state "None".]

2. Customer Payment to Company for Company Interconnection Facilities, Review of Facility, and Acceptance Testing

The Customer shall pay to the Company the total estimated interconnection cost to be incurred by the Company (Total Estimated Interconnection Cost), which is comprised of (i) the estimated cost of the Company Interconnection Facilities, (ii) the estimated engineering costs associated with a) developing the Company Interconnection Facilities and b) reviewing and specifying those portions of the Facility which allow interconnected operations as such are described in Exhibit B, and iii) acceptance testing. The following summarizes the Total Estimated Interconnection Cost:

<u>Description</u>	<u>Estimated Cost (\$)</u>
[Need to specify the estimated interconnection cost. If no cost, state "None".]	
Total Estimated Interconnection Cost	\$

The Total Estimated Interconnection Cost, which, except as otherwise provided herein, is non-refundable, shall be paid by the Customer fourteen (14) days after receipt of an invoice from the Company, which shall be provided not less than thirty (30) days

prior to start of procurement of the Company Interconnection Facilities.

Within thirty (30) days of receipt of an invoice, which shall be provided within fourteen (14) days of the final accounting, which shall take place within sixty (60) days of completion of construction of the Company Interconnection Facilities, the Customer shall remit to the Company the difference between the Total Estimated Interconnection Cost paid to date and the total actual interconnection cost (Total Actual Interconnection Cost). The latter is comprised of (i) the total costs of the Company Interconnection Facilities, and (ii) the total engineering costs associated with a) developing the Company Interconnection Facilities and b) reviewing and specifying those portions of the Facility which allow interconnected operations as such are described in Exhibit B, and iii) acceptance testing. If in fact the Total Actual Interconnection Cost is less than the payments received by the Company as the Total Estimated Interconnection Cost, the Company shall repay the difference to the Customer within thirty (30) days of the final accounting.

If the Agreement is terminated prior to the Customer's payment for the Total Actual Interconnection Cost (or the portion of this cost which has been incurred) or prior to the Company's repayment of the overcollected amount of the Total Estimated Interconnection Cost (or the portion of this cost which has been paid), such payments shall be made by the Customer or Company, as appropriate. If payment is due to the Company, the Customer shall pay within thirty (30) days of receipt of an invoice, which shall be provided within fourteen (14) days of the final accounting, which shall take place within sixty (60) days of the date the Agreement is terminated. If payment is due to the Customer, the Company shall pay within thirty (30) days of the final accounting.

All Company Interconnection Facilities shall be the property of the Company.

3. Operation, Maintenance, Testing, and Replacement Costs

The Company will bill the Customer monthly and the Customer will, within 30 days after the billing date, reimburse the Company for any costs incurred in operating, maintaining, testing or replacing the Company Interconnection Facilities. The Company's costs will be determined on the basis of outside service costs, direct labor costs, material costs, transportation costs, applicable overheads at time incurred and applicable taxes. Applicable overheads will include such costs as vacation, payroll taxes, non-productive wages, supervision, tools expense, employee benefits, engineering

administration, corporate administration, and materials handling. Applicable taxes will include the Public Service Company Tax, and Public Utility Fee.

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF HAWAII

In the Matter of the Notice of)	
)	
HAWAIIAN ELECTRIC COMPANY, INC.)	Transmittal No. 02-01
)	
To modify its Rule 14 to establish Interconnection)	Effective
Standards and to require an interconnection)	Date: February 15, 2002
agreement for distributed generating facilities)	
operating in parallel to the Company's electric)	
electric system)	
_____)	

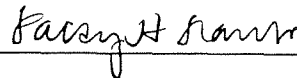
CERTIFICATE OF SERVICE

I hereby certify that on January 15, 2002, I served two copies of the foregoing Transmittal No. 02-01, dated January 15, 2002, together with this Certificate of Service, by personal service to the following, at the following address:

Gregg J. Kinkley
Executive Director
Division of Consumer Advocacy
Department of Commerce and Consumer Affairs
250 South King Street, Room 825
Honolulu, Hawaii 96813

Dated: Honolulu, Hawaii, January 15, 2002.

HAWAIIAN ELECTRIC COMPANY, INC.



Patsy H. Nanbu

